The Geophysical Institute
QUARTERLY

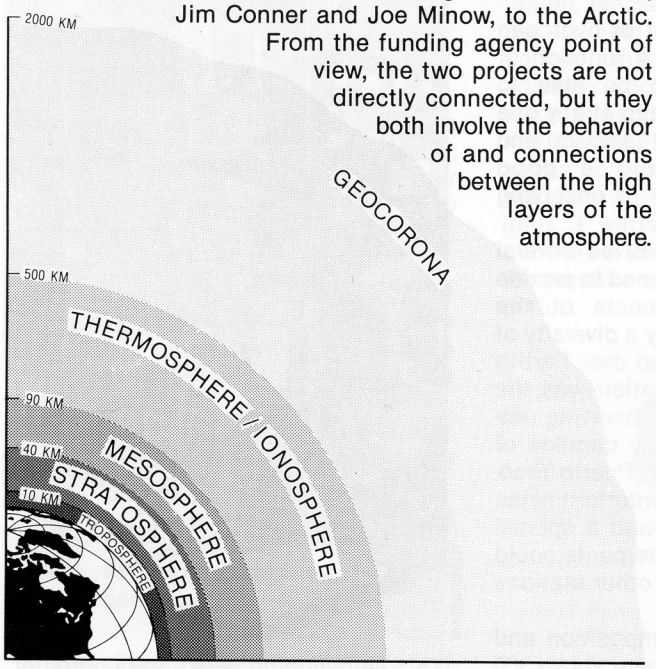
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Aeronomers need antarctic, arctic perspectives

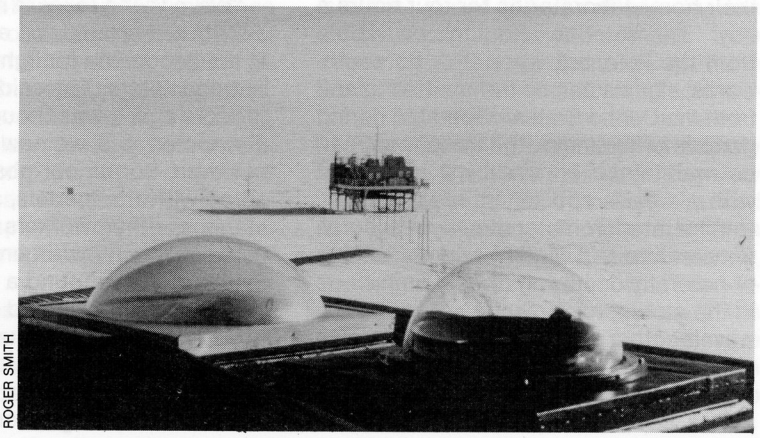
For most of our history, humankind was content to know what it could of only one layer of the atmosphere: the troposphere, or breathable air where weather occurs. Then, as the possibilities of radio communication caught our attention, so did a higher layer: the ionosphere, where ultraviolet light from the sun affects air molecules and atoms so they can conduct electricity and reflect radio waves back to earth at points distant from their source. Today we go rocketing through all the atmospheric layers, and have come to understand that each of them affects the others.

This is where the work of Roger Smith and his colleagues in the field of aeronomy comes in. Smith, a professor of physics at GI, uses optical techniques to investigate the dynamics of the upper atmosphere at high latitudes. This year his work called for projects in both Antarctica and the Arctic.

During last winter, Smith traveled to the U.S. South Pole Station to install equipment for new research and he supervised a project that took two institute graduate students, Jim Conner and Joe Minow, to the Arctic. From the funding agency point of view, the two projects are not directly connected, but they both involve the behavior of and connections between the high layers of the atmosphere.



Atmospheric layers and their approximate heights are identified by differences in composition and processes.



ROGER SMITH

Skylab at South Pole Station is seen here from its 20-square-foot roof. The interferometer dome is on the right; the station's clean air facility can be seen in the background.

In the Antarctic, wind direction and temperature in two atmospheric layers, the thermosphere and mesosphere, are being measured. "Ground-based exploration of the thermosphere in the southern polar cap is now in its early stages, with previous scattered measurements reported from Halley and Mawson," Smith said. His new project will also make the first optical measurements of the antarctic mesosphere.

He and his colleague, Gonzalo Hernandez of the University of Washington, installed a new Fabry-Perot interferometer for these measurements. "In basic principles, it's the same instrument as one we have in Svalbard, but I call that one my Mark I. If you look closely, you can still see the baling wire and sealing wax.

"The antarctic instrument was designed by Dr. Hernandez and about half of it was constructed at the Geophysical Institute. When Jim Baldridge got done testing and revising its computer control, it was by far the most sophisticated either Hernandez or I have ever used."

Baldridge is a computer expert assigned to provide technical support for GI optics research. "Much of what he did involved the application of well-known principles, but the real innovation came in making what was a stand-alone device into a time-sharing one," Smith said. The 2,000-pound interferometer can receive instructions from the researchers as it carries out previously assigned tasks.

This time-sharing capability, plus a fortunate wobble in the orbit of a communications satellite geostationary above the Equator, means the scientists can indirectly control the interferometer from

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ROGER SMITH

A C-130 cargo plane unloads fuel for the South Pole Station generators, February 1989.

Aeronomers

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their home laboratories for four hours a day. "The satellite shouldn't be visible from the Pole, but when it drifts southwards, signals can be transmitted to and from the United States." Operated during periods of darkness, the instrument can be maintained on site by a nonexpert with a week's special training.

"The interferometer directly measures temperature and wind by remote sensing of naturally occurring optical emissions in the atmosphere," Smith said. "Certain wavelengths of the spectrum relate to specific heights in the atmosphere."

The instrument has two parallel glass plates, separated by a variable distance of a few centimeters, that are partially reflective on their inner surfaces. Between them, the two plates multiply reflect incoming light. Emerging through a small aperture, the transmitted light is measured using a cooled photomultiplier. This spectral information is saved in disk files and periodically transmitted to Alaska using a computer network.

Because Antarctica is cold, buildings are well-sealed and insulated, making it necessary to protect the electronics from overheating. "This has been one of our major problems," Smith said. "Also, the refrigerator cooling the interferometer's detectors was apparently damaged in transit, and after six months of operation, we've lost half the alcohol coolant. There's probably a tiny leak, and the air is so dry at the Pole, the drip just evaporates before it can be seen." He expects new refrigeration to be installed in October.

Smith's attention was also on Svalbard, an arctic archipelago administered by Norway, where his team was observing the geocorona. This cloud of hydrogen atoms, which glows in sunlight, really is the atmosphere's last gasp, lying more than 500 kilometers up. It was discovered only in 1955.

"We're trying to learn how hydrogen is distributed around the earth by looking at the geocorona for light scattered from hydrogen atoms," he said. "Twenty or thirty years ago, it was thought to be evenly distributed, but we now know that it is not even. So far, our observations don't agree with the models, and in some instances, other workers have observed twice as much hydrogen as expected. In Svalbard, we've found a good bit of ionized hydrogen dumped in by the solar wind, but we've also found that the density of hydrogen atoms is lower than predicted by theory."

Because hydrogen ions coming from the sun are traveling fast, their spectrum is shifted enough by the Doppler effect that instruments can easily distinguish them from the slower-moving atoms resident in the geocorona.

Smith said the amount of hydrogen observed appears to be a function of latitude. "We expect to be able to describe how it's distributed at any one time by looking at overall temporal and spatial variations using a good geographical distribution of observing stations."

The project, which involves several research centers, was planned to provide simultaneous measurements of the geocorona as observed by a diversity of instruments widely spread over Earth's surface. The Svalbard station was the northernmost part of an observing network spanning some sixty degrees of latitude, from Svalbard to Puerto Rico. Operating the Svalbard interferometer, Connor and Minow followed a special schedule so their measurements could be related to those from other stations in a meaningful way.

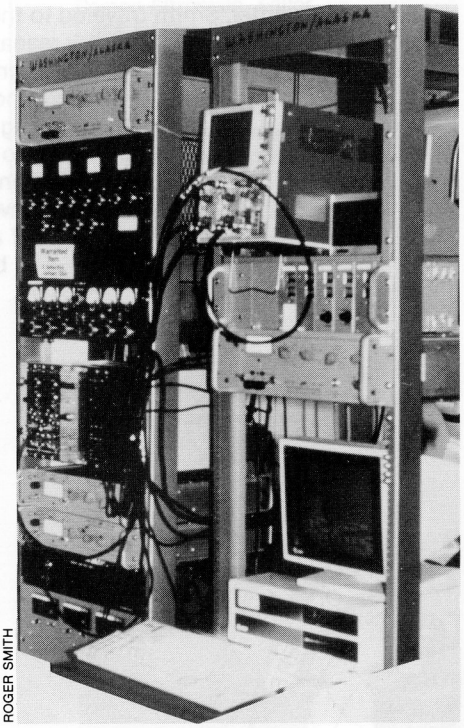
Understanding the composition and dynamics of our atmosphere above 300 kilometers (186 miles) relates to its evolution and the evolution of planetary atmospheres in general. Understanding how atmospheric gases are lost to space is central to the comprehension of the present volatile inventory of the terrestrial atmospheres, which are known to be highly diverse. By extension, the effects of human activity upon the evolutionary process is of growing concern.

Measuring composition and particle velocity distributions will also help explain the physics of atmospheric regions where atoms are not subject to frequent collisions and therefore follow orbital paths, like small satellites. This condition is also an excellent laboratory for studying questions related to such fields as cometary atmospheres, solar and polar winds, gaseous expansion into a vacuum, gas centrifugation, and evaporation of stars from clusters.

The Svalbard project is associated with a major, national research initiative (1986) to study the coupling, energetics, and dynamics of atmospheric regions, or CEDAR, as it's called. CEDAR is funded and organized by the National Science Foundation to promote understanding of atmospheric processes and relationships at different altitude regions of the atmosphere.

A $60,000 grant from the Aeronomy Program of the National Science Foundation Division of Atmospheric Sciences funded the Svalbard study. The antarctic project is funded by a $550,000 grant from the National Science Foundation Department of Polar Programs.

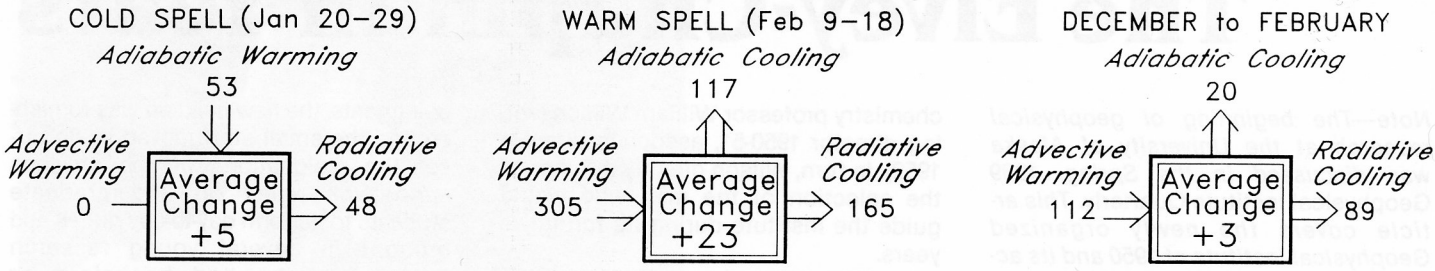
—Carla Helfferich



ROGER SMITH

This self-aligning servo and computer control support the interferometer at the South Pole.

Heat budgets account for temperature extremes



Tanaka's heat budget analysis shows the net average temperature change for periods during last year's unusual winter.

Alaska's 1988-89 winter was an abnormal one. Weather stations recorded above-normal temperatures in December, then two weeks of severe cold (in Fairbanks, consistently below -40°F), then a number of record-breaking highs in February. Overall, the three-month average temperature for December through February was above normal at most Alaska weather stations, despite the impressively severe cold in late January.

What this shows, other than not to dress for averages, is a subject of extreme interest to Hiroshi Tanaka, newest member of the Geophysical Institute's research staff for atmospheric sciences.

"The clear warming trend in Alaska has been one of the supports of the global warming scenario, the heating caused by anthropogenic greenhouse gases," he said. "From the climate models devised so far, based on global three-dimensional general circulation models, the prediction is that the warming should occur along with an enhanced variability of daily weather, and a consequent increase of abnormal weather, especially in the high latitudes."

Alaska has seen more than a decade of warmer than normal weather; since 1977, forty-below temperatures have been rare (see *Quarterly*, Vol. 6, No. 3, 1988). Along with the abnormal winter just past, does this mean we're actually seeing the greenhouse effect?

Tanaka's answer: We can't tell yet, because we don't know enough about the smaller-scale processes that were responsible for the extreme effects seen during winter 88-89. To investigate the causes of those weather patterns, Tanaka approached the problem thermodynamically, using a conceptual tool known as a heat budget.

A heat budget analysis is possible because we know that any temperature variation obeys physical laws. The essential relation is:

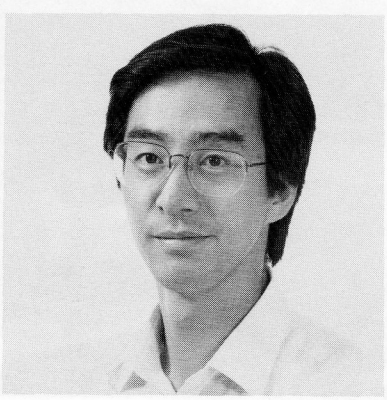
Temperature change = heat supply + adiabatic heating + advection

Heat supply includes radiative heating or cooling—heat gained directly from sunlight or lost to space as the earth radiates it away.

Adiabatic heating refers to the change in heat content of an air column caused when vertical motion of air results in mechanical compression or expansion. Expanding air cools, and compressing air warms. In Alaska valleys and basins during winter, for example, the downward motion of air associated with stable, stratified atmospheric conditions actually increases the temperature of the compressing air.

Advection describes horizontally moving air. In a given locality, the temperature may change because warmer (or colder) air comes sliding into the region.

In the heat budget equation, consistent units of energy can be assigned to all these elements. For the three-month average heat budget in Alaska (see figure), Tanaka's analysis showed advective warming (equivalent to 112 watts per square meter) balanced against adiabatic cooling from ascending air (20 watts per square meter), and (since the sun contributes little heat during the subarctic winter) radiative cooling (89 watts per square meter). The imbalance (plus 3 watts per square meter) contributes to the actual average temperature change of the air during this period.



Hiroshi Tanaka joined the institute last year after receiving his doctorate from the University of Missouri-Columbia.

The immediate cause of the January cold spell was a large-scale ascending motion in the air, which led to its adiabatic expansion and chilling. The severe cold was maintained because the usual inflow (advection) of warm air was reduced. This was caused when a persistent zonal flow pattern in the midlatitudes prevented Alaska from receiving air parcels from the south. In fact, the state instead received cold arctic air by advection near the surface.

Also stemming from weather activity elsewhere, the abnormally high February temperatures came from an enhanced advection of warm air. This advection was associated, as Tanaka explains it, "with a dominant meridional flow induced by a blocking formation in the North Pacific." A stubborn high-pressure cell off the Washington and Oregon coasts was shunting warmer air up into Alaska.

"We found that a notable variation of vertical motions contributed to the temperature variation leading to the anomalous advective heating," Tanaka said. "The radiative process appears to act passively to reduce rapid temperature variation."

Tanaka's analysis showed that the abnormal weather in Alaska was caused by large-scale, low-frequency atmospheric dynamics such as advection rather than radiative cooling. Radiative cooling has long been accepted as the essential cause of cold winter temperatures in the high latitudes, and radiation is the crucial physical process affected by greenhouse gases.

"Finding the fundamental causes of low-frequency atmospheric variability is beyond the scope of our knowledge, though active research has been conducted on the subject for decades. Until we understand this kind of variability, how can we predict climate change?"

Dr. Tanaka is pursuing just such an understanding, and he is the first to admit that much work lies ahead—even with a laboratory as big, and as interesting, as the air above Alaska to house his efforts.

—Carla Helfferich and Hiroshi Tanaka

INSTITUTE HISTORY

The Elvey-Chapman Years

Note—The beginning of geophysical research at the University of Alaska was discussed in the Spring, 1989 Geophysical Institute Quarterly. *This article covers the newly organized Geophysical Institute of 1950 and its activities through 1962. It is based on interviews with T. Neil Davis, Charles (Buck) Wilson, and written materials.*

Although substantial research contracts had been carried out at the University of Alaska prior to 1950, the congressional act establishing the Geophysical Institute and federal construction money focused the effort to create a high-latitude research center. Stuart Seaton, the institute's first director, had been a strong advocate for such a facility in the American Arctic, but after only nine months, he resigned following administrative disagreements with the university. Because most of the staff resigned with Seaton, very few people were left to carry on the research programs in the newly completed building.

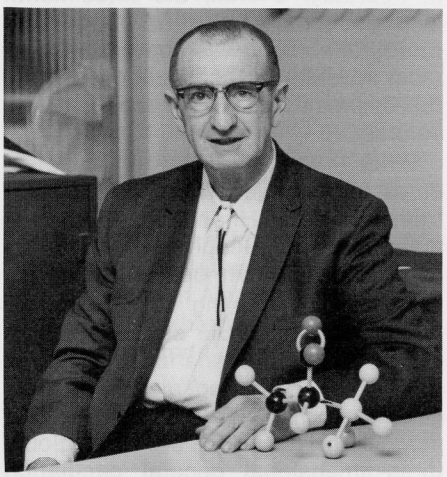
To run the institute on an interim basis, UA President Terris Moore appointed chemistry professor William Wilson (acting director 1950-51, associate director 1952). In turn, Wilson directly influenced the selection of the men who would guide the institute during its formative years.

In 1951, Wilson recruited a distinguished geophysicist and mathematician, Sydney Chapman, to serve as advisory scientific director and visiting professor. Chapman, recently retired Sedleian Professor of Natural Philosophy at Oxford, brought to the institute his considerable scientific reputation and a keen interest in fostering a North American center for high-latitude research and graduate study. He applied his many talents to that goal, spending part of each year at the institute until his death in 1970.

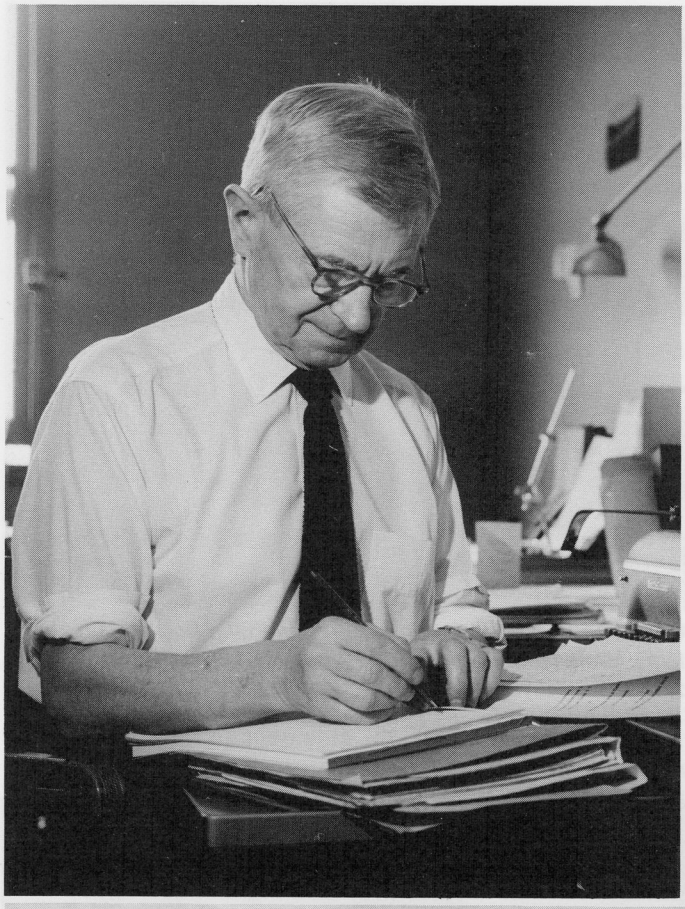
Wilson also participated in the selection of the new director, Christian (Chris) Elvey. A well-known astronomer, Elvey had been associated with Yerkes Observatory, Northeastern University, McDonald Observatory, and other institutions. He managed the Geophysical Institute from January 1952 through June 1963.

As Wilson negotiated for these appointments, the new building was furnished and the small staff moved in. To offset the resignations of the previous spring, he relied on undergraduate students to perform day-to-day duties and brought in several young research associates who had bachelor's or master's degrees but possessed little experience.

"When I arrived at the University in the fall of 1951, the institute was mostly deserted. There was this new building with only about six staff members," said Charles (Buck) Wilson, who was one of the research associates.







Pictured (clockwise from bottom left): graduate student Jerry Romick and Director Chris Elvey, Acting Director Bill Wilson, Advisory Scientific Director Sydney Chapman, and the first Geophysical Institute building.

"Arriving in Fairbanks in midwinter (1952), Dr. Elvey found what he described as '...Professor Chapman and a bunch of boys..'," Buck Wilson said in his history of the early teaching program (*GI Annual Report 1977-78*).

That year Elvey formed and headed a department of geophysics from which a M.S. degree could be earned. In 1953, following Chapman's strong recommendation, a physics department was also created. Willibald Weniger headed that department and Alfred Bork came from Brown University to teach graduate physics courses.

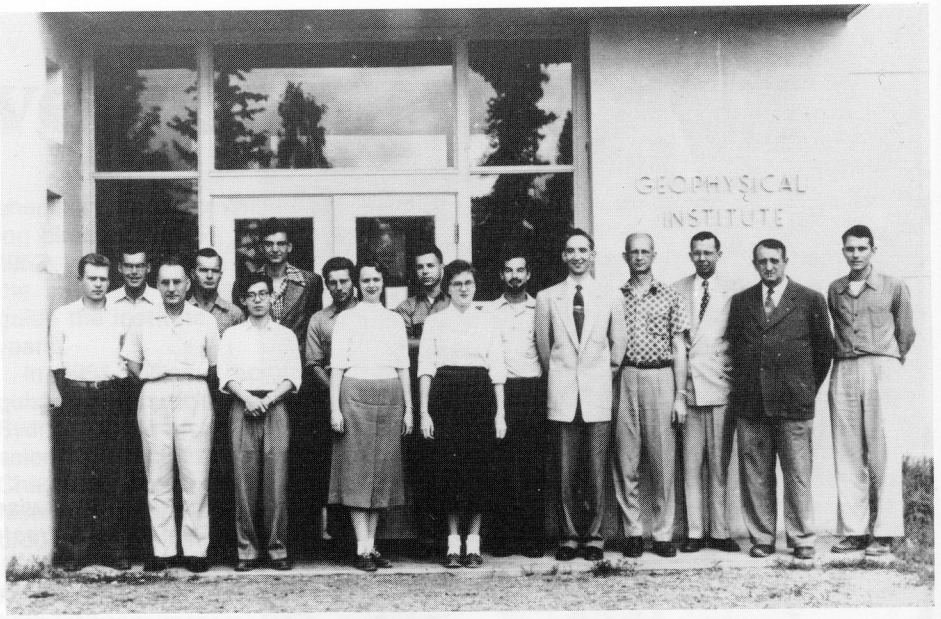
The March 1952 catalogue listed the research associates: Soren Anderson, Joseph Cain, James Heppner, Richard Krepps, Harold Leinbach, Gilbert Monroe, Wade Peterson, and Buck Wilson; Theodore Lachelt was a graduate assistant. Other early arrivals were Howard (Skip) Bates, Joe Pope, Bob Leonard, Al Belon, T. Neil Davis, and Ernie Stiltner. The 1953 catalogue listed 33 institute staff members, eleven graduate courses in geophysics and nine in physics.

Davis, later a professor and deputy director of the institute, arrived as a college freshman in 1951 and worked briefly on an ozone monitoring experiment. "When I returned as a junior student in 1952, I worked as an expediter, then as a research assistant," he said.

"Scientific staffing was still a serious problem when Dr. Elvey took over in 1952, so he brought in several talented graduate students and senior scientists from other schools to work during the summer months. Much of their work was in the field of radio physics, a direction toward which the institute was moving, largely because of the interests of military funding agencies," said Davis.

"At the time, a very important issue was to learn more about polar radio propagation, in particular how the aurora and related phenomena affected it. The summer workers brought in by Wilson and Elvey contributed much to the vitality of the institute, but each fall when they left, their work had to be picked up by others. In several instances this meant resident undergraduate students, including myself, Al Belon, Joe Cain, and Jerry Romick. This was, of course, a fantastic opportunity for us—the chance to do real science while our equals at other schools were still learning by performing set experiments in physics and chemistry laboratories."

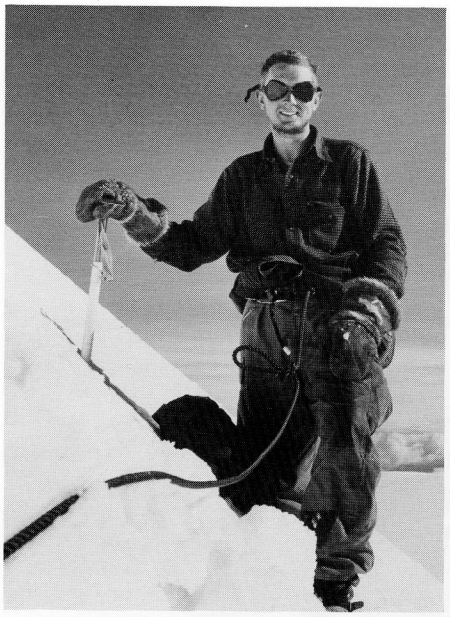
Research during the fifties centered on the radio physics and auroral observation. Then, as now, the institute largely depended on contracts and grants to support its research. Part of Elvey's job was to convince the Washington science establishment that the institute was collectively stable and talented enough to



Summer 1954: Joseph Cain, Kenneth Bowles, Victor Hessler, Philip Bettler, Masahisa Sugiura, George Swensen, Louis (Ted) Kegler, Ann Huber, Rolf Dyce, Carol Echols, Joseph Pope, C. Gordon Little, Raymond Roof, C. T. Elvey, William Wilson, and Charles Genaux.



A converted walk-in freezer provided a less than ideal housing for the optical observatory at Ballaine Lake, where Jerry Romick is pictured reading data from the meridian scanning photometer.



Buck Wilson on Mt. Wrangell during an expedition to establish a cosmic-ray observatory in the early 1950s.

warrant federal sponsorship of its research projects. Elvey worked hard at funding and was successful enough to keep the staff and students working.

Because research pushes the limits of knowledge and materials, projects don't always work out as planned. In the days before down jackets and sophisticated equipment, the research staff was particularly challenged by the logistics of northern research.

Buck Wilson related an early project that occupied the summers of 1953 and 1954. "We had a contract to place a neutron monitor on top of Mt. Wrangell for observing cosmic rays," he said. "To build the observatory, some of us had to climb to the summit after being landed at the 3,000-meter level. The Air Force parachuted in materials for the station and we built it the first year. During the second summer, we tried to get the neutron monitor working. It did work on and off, but never properly, because the generator shaft was bent during the air drop." For a time, University of Alaska President Terris Moore flew his plane to support the expedition.

One of the first major experimental projects to go from inception to completion was a ground-conductivity project sponsored by the Navy through the Signal Corps. "The task was to develop a technique for measuring the electrical conductivity of the ground at low radio frequencies and then make an electrical conductivity map of Alaska," said Davis. Begun in summer 1952, the project lasted about five years.

"Skip Bates worked on it initially, collecting soil samples I analyzed in the lab in early 1953," Davis said. "But this looked like a never-ending process of questionable validity, so with the advice and tutelage of Bates, who at least knew something about the ways of radio waves, I developed an airborne method for determining conductivity over large areas by measuring the attenuation of sub-broadcast band radio transmission."

Tests of the method were successfully completed on April 27, 1953. "Shortly thereafter, Glenn Stanley, a graduate of Oregon State, came to Alaska and we further refined it. Then Buck Wilson also came on and did part of the flying and analysis work."

The technique required considerable flying at low altitudes. "We could get along with 200-300 feet, but I kept us as close to the tree tops as possible, and over the tundra, we went for about 200 feet," Davis said.

"The project involved flying approximately 20,000 miles in a light plane at an altitude of only 300 feet or so," recalled Buck Wilson. "There were radio beacons at every airfield in Alaska from which we flew radially in different directions, skimming the surface to determine how far the radio signal traveled. The plane was an Aeronca Sedan. With the pilot, a passenger, and all the equipment, it was rather underpowered."

"Especially on floats," added Davis. "To get off the water, we had to rock the plane up on the step by shifting our bodies back and forth." In 1955, Stanley and Davis published the study's main end product, a conductivity map of Alaska. The same year, Davis received his bachelor's degree, the first in geophysics awarded by the University of Alaska.

As Elvey continued to secure funding for research projects, the graduate program developed under Chapman's guidance. As a scientist and teacher, Chapman has been celebrated for his worldwide influence on three generations of geophysicists, with a direct influence that nearly spans the twentieth century. His accomplishments are recorded in *Sydney Chapman, Eighty, from His Friends* a tribute published in 1967 and edited by Syun-Ichi Akasofu, Benson Fogle, and Bernhard Haurwitz.

"Graduate studies really began with Chapman's arrival," Davis said. "He attracted several very senior graduate students, namely Masahisa Sugiura, Wesley Brittin and Ben Nichols." Sugiura earned the university's first doctorate in 1955. "Brittin and Nichols graduated in 1957, but they already held faculty positions at other schools, and at least in the case of Brittin, the work was largely done elsewhere," Davis said.

"Sugiura's work, a massive analysis of the global characteristics of magnetic storms, required the employment of a number of scaling technicians, collectively known as Sugi's Harem," he recalled. The technicians were Marsha Green, Sandra Fuller, and Jeanne Hume.

"I was hired and began to work with Dr. Sugiura as a human computer—with pencil in hand and a ten-key adding machine," said Hume, now an ad-



Small planes and low flying characterized the ground conductivity project. Here Glenn Stanley carries a reel used in conjunction with an antenna that was dangled from airplanes during flights that covered the state.

ministrative assistant at the institute. "I'll never forget that first job or Dr. Sugiura, my first boss....I worked four years with this taskmaster, loved every day of the job, and thought the entire world worked as hard and accomplished as much as we did," she said, recalling two daily coffee breaks, precisely 15 minutes each, during which Sugiura and the technicians worked jig-saw puzzles. Not a word was spoken between breaks.

Davis remembered that Brittin was required to rewrite his highly complex theoretical thesis when Chapman couldn't understand it. "Chapman was of the opinion that if he couldn't understand it, then no more than one or two others in the world could either. Certainly no one else at the University of Alaska could. As far as I remember, in the 1950s that was the only theoretical work of any significance done under the guise of the institute."

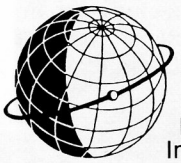
In the early fifties, experimental work mainly involved monitoring of such things as ground-level ozone concentrations, the effect of the subarctic environment on paint products, the structure of the auroral ionosphere (using an ionosonde), the composition and structure of the neutral atmosphere (using the scattering of light from searchlights beamed upward) and the effects of the auroral ionosphere on man-made radio waves reflected from it. To determine the effect of the aurora on radio propagation, a detachment of Signal Corps personnel assigned to the institute manned an extensive program of visual auroral observation and monitoring of the intensity of radio signals reflected by the ionosphere over Alaska.

Buck Wilson related one side effect of the ionospheric sounder research that got the attention of everyone on campus. "It involved a large antenna set up outside the institute to measure reflected radio waves to obtain an electron density profile of the ionosphere. Every 15 minutes, the equipment emitted a 30-second pulse. For the duration of the pulse, every radio on campus was disrupted."

"Perhaps the most significant scientific achievement of those early years was the determination of a close relationship between visual aurora and ionospheric currents," said Davis. "James Heppner, one of the young men brought in by Dr. Wilson, did this work and for it received his Ph.D. from the California Institute of Technology in 1954. Considered a classic, Heppner's thesis received so much acclaim that it was published and widely distributed. Another important result, co-authored by Albert Belon at about the time he graduated, was the discovery of a close association between visual aurora and enhancements of electron density in the lower ionosphere."



The institute's first Ph.D. graduate, Sugiura Masahisa, gets a skating lesson from Jeanne Hume, one of his technicians (right), and Carolyn Quimby, another institute staffer (GI photo, 1957).



During the years 1955-57, activity focused on preparing for the upcoming International Geophysical Year (IGY). Chapman was instrumental in creating the IGY, a worldwide effort to expand the scope of the earlier Polar Year research (1882 and 1932). As president of the IGY organizing committee, he provided vital leadership and energy for this 18-month project, a coordinated, international effort to measure Earth's physical characteristics.

The institute staff contributed to the IGY by developing several instruments and emplacing others that had been developed elsewhere. Equipment developed here that later proved of high scientific value were the all-sky camera (Elvey), the riometer (Little, Leinbach and Merritt), and the meridian scanning photometer (Clark, Belon, Romick). During this period a number of cooperative efforts with others began to evolve, especially with personnel of the Stanford Research Institute, who also brought instrumentation to the campus.

With the arrival of C. Gordon Little and other senior radio-physics people, the institute's work before 1957 leaned heavily toward studies of the ionosphere using radio techniques. Arriving from England in 1954, Little brought the idea for a relative ionospheric opacity meter, or riometer. Used extensively in ionospheric research, riometers determine and record the level of exterrestrial radio noise to measure changes in ionospheric absorption of electromagnetic waves. Working with Little and his graduate student, Harold Leinbach, Robert Merritt of the electrical engineering department designed the equipment. The first such instruments were built in institute shops.

"Elvey, being more oriented toward optical techniques, desperately wanted to build up that area of work. He was well aware that much needed to be learned about the characteristics of the optical aurora and that College was an ideal location," said Davis. "One tool he tried to develop was the all-sky camera, a device that Carl Gartlein of Cornell had begun using on the aurora. As the IGY approached, Elvey took on the responsibility for developing an all-sky camera for use by the United States at its many planned observing stations in the northern and southern hemispheres.

"Lacking any better talent to apply to the task, Elvey put me to work on it," said Davis. During the summer of 1955 he designed and built several cameras



During his long association with the institute, special technical assistant Art Schiavulli worked with Chris Elvey and Neil Davis on developing the all-sky camera.

which later became known as the British Model All-sky camera. Some of these were used during the IGY in Alaska and the Antarctic, but Elvey decided the camera was too bulky and unsuitable for antarctic use. Davis left for graduate school and Elvey contracted with a company in the States, Photomechanisms, Inc., to design a new camera—the model currently at the UA Museum.

"This camera was called the United States Model All-Sky Camera, and sometimes the Elvey-Davis All-Sky camera, although I had absolutely nothing to do with it," Davis said. "The funny thing was that the first camera took better pictures than the second one, but it was of poor electrical design."

Highly significant was the arrangement made by Chapman and Elvey for the location of one of the IGY Data Centers at the Geophysical Institute. Part of World Data Center A (the U.S. center; other centers were in Europe and the Soviet Union), it would receive all of the station magnetometer and all-sky camera data taken worldwide. Thus, the institute later became one of two sites (Fairbanks and Moscow) where this important combined data set was available for analysis, and the availability of the data allowed the staff to achieve important results in the post-IGY era.

The IGY was a massive undertaking for the Geophysical Institute, where the staff was expanded and a substantial National Science Foundation grant funded the work. During this period, new scientific staff members included R. Parthasarathy, Manfred Rees, G. Reid, and Robert Hunsucker. Several graduate students arrived who would later join the faculty: Syun-Ichi Akasofu, Robert Benson, Charles Deehr, Gene Wescott; other students included Roy Basler, Rene Cognard, Ronald DeWitt.

Along with the varied instrumentation in the Fairbanks area, GI operated an extensive network of all-sky camera, auroral radars, riometers and other instruments elsewhere in Alaska. This network was part of an even larger one that extended up through northern Canada to the geomagnetic pole near Thule, Greenland.

The Alaska network involved stations at Kotzebue, Cold Bay, Unalaska, Point Barrow, Farewell, Bettles, and Fort Yukon. Davis was in charge of operating the outlying stations, working with the several principal investigators, including Harold Leinbach and Bob Leonard. He was also principal investigator for the all-sky cameras.

"All of us were graduate students at the time, and we did all the installation work," he said. "This was partly because a lot of tower-climbing was involved and insurance considerations precluded the use of the formal technical staff unless special, unaffordable payments were made. The insurance carriers didn't consider graduate study a dangerous occupation; little did they know of the brutalities committed on students by college professors."

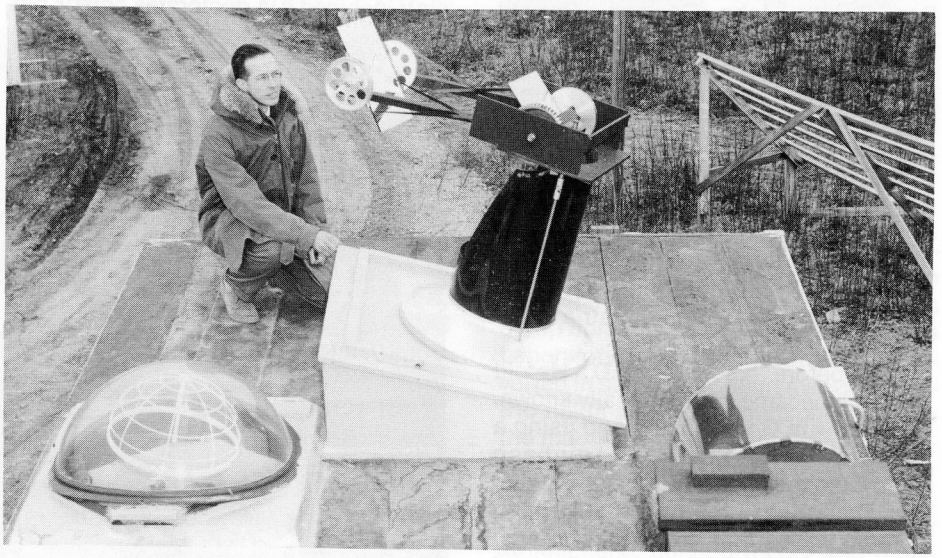
During the IGY, Buck Wilson spent 13 months either in or traveling to and from Antarctica. "I was the first person from the institute to go there," he said. "Elvey got me a position doing auroral studies at Little America #5 on the Ross Ice Shelf...We took all-sky cameras and a meridian spectograph." At the time it took 28 days to go by ship from San Diego. Wilson, who was appointed to the faculty in 1963, made ten more trips to Antarctica in future years.



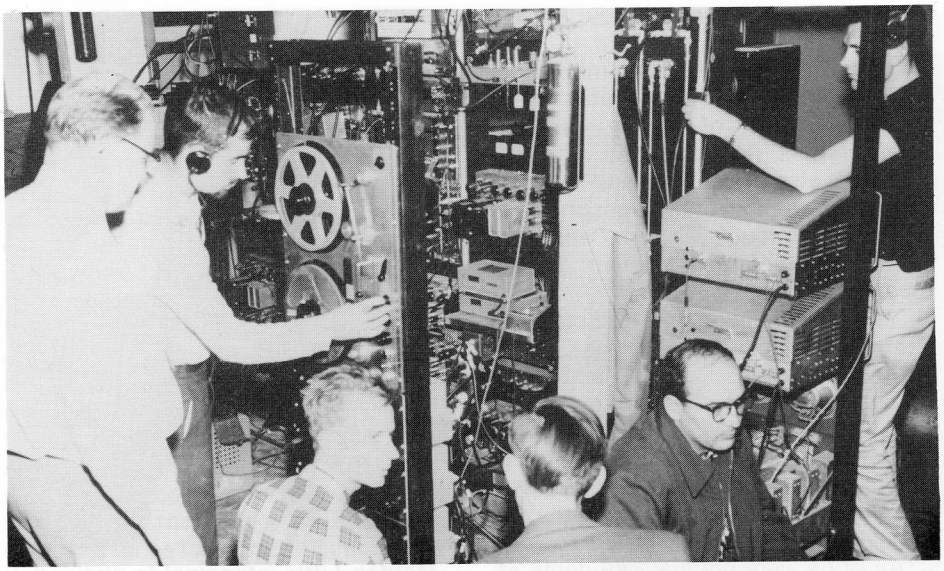
Gordon Little (standing) is pictured with radio telescope equipment at Ballaine Lake.

Just as the IGY was starting up, the institute played a fortuitous role in a technical coup by the Soviet Union. "The October 4, 1957 launch of Sputnik was the most exciting event of the 1950s at the institute," said Davis. "All eyes in the Western World turned skyward, but the first to see the new object was one of our graduate students—with the possible exception of the man described in *Alaska Science Nuggets*" (Davis, p. 31, Geophysical Institute, 1982).

"Learning that the satellite was up, our assistant director Gordon Little immediately mobilized essentially the entire staff. Within hours, equipment at Ballaine Lake associated with the 28-foot diameter dishes of the interferometer (the radio-telescope) was converted to a satellite receiver.



Visiting professor Kenneth Clark of the University of Washington is pictured with the periscope of the Hunten spectrometer at the Ballaine Lake optics observatory. During and after IGY, Clark greatly influenced excellent photometric and spectroscopic auroral research by students such as Jerry Romick, Al Belon, and Chuck Deehr.



In 1957, the first official North American visual sighting of Sputnik 1 was made by graduate students Robert Leonard and Joseph Pope, as they recorded its radio signals using a radio telescope at Ballaine Lake. Listening in are Robert Merritt, Pope, Pete Michelow, Gordon Little, Glenn Stanley, and Ernest Stiltner.

"Early on the morning of October 6, the staff picked up the first signals and saw the new satellite. The data they obtained, some of it photographic, was crucial to the first determinations of the satellite's orbit. Aside from all else it accomplished, Sputnik brought a sudden sense of importance to the institute's IGY activities."

With the end of IGY, emphasis shifted to analysis work which continued well into the early 1960s. One result was the production of numerous Ph.D. graduates: (1961) Syun-Ichi Akasofu, Howard Bates, T. Neil Davis, and Robert Leonard; (1962) Harold Leinbach; (1963) Ziauddin Ansari, Robert Benson, Charles Wilson; (1964) Gerald Romick, Eugene Wescott; (1965) Roy Basler, John Dawson, Ronald DeWitt.

"An indication of the value of the IGY observations and their subsequent analysis at the institute was that many of the young people involved became well known in the worldwide scientific community even before receiving their Ph.D.s," Davis said. "Their work clearly influenced the work of others who were making important contributions to the understanding of solar-terrestrial relations."

Well before his 1961 Ph.D., Harold Leinbach became internationally known. Working with Gordon Little and using a network of riometers, Leinbach discovered the phenomenon called Polar Cap Absorption—the heavy absorption of radio waves that propagate through the ionosphere. It occurs when great floods of low-energy solar protons from intense solar flares penetrate the polar atmosphere, causing radical changes in the lower ionosphere.

Another contribution from IGY data analysis was development of the AE Index (auroral electroject) by Davis and Sugiura. "It replaced the Kp index of years gone by as the scientific community's primary measure of magnetospheric activity." Davis said. "But the greatest IGY-related accomplishment—equal or greater in significance to the concepts of magnetospheric convection and magnetospheric reconnection—was Syun-Ichi Akasofu's discovery and documentation of the magnetospheric substorm. Much hard work and great insight on his part led to this crucial step in the greater understanding of our global environment."

In mid-1963, the institute's scientific staff included (UA doctorates noted): professors Russell Carr, Sydney Chapman, Warren Flock, Victor Hessler, Keith Mather (director), Leif Owren, Masahisa Sugiura ('55, on leave); associate professors Syun-Ichi Akasofu ('61), Howard Bates ('61), Albert Belon, Carl Benson, T. Neil Davis ('61, on leave), Robert Forbes, Wallace Murcray, R. Parthasarathy, Harold Peyton; assistant professors Ziauddin Ansari ('63), Robert Benson ('63), Edward Gauss, Robert Hunsucker, Daniel Swift, Charles Wilson ('63); assistant geophysicists Benson Fogle ('66), Richard Heacock, Gerald Romick ('64), and Charles Deehr ('68).

The Geophysical Institute came of age during the Elvey-Chapman years, as the two men established a respectable program for research and graduate education. Practical and effective, they managed to build a faculty, attract students, obtain research funding and create an unparalleled network of observing stations during the IGY. Because several students who matured under their guidance later made major contributions to the institute, the Elvey-Chapman influence was carried on well beyond their tenure.

Both Elvey and Chapman died in 1970, within a few months of each other. Chapman had retained his advisory role until his death. Elvey continued his association with the university as a research professor. During the two years prior to his 1963 retirement from the institute, Elvey served as UA vice chancellor for research and advanced studies, while Victor Hessler ran the institute as acting associate director. Keith Mather began his tenure as institute director in July 1963.

—Doreen Fitzgerald



Ron DeWitt, Chuck Deehr, and Gene Wescott greet fellow student Syun Akasofu on his return from a 1959 trip to Colorado with Sydney Chapman. Their vividly expressed sentiments: "Welcome back" and "Kill the dean of students!"



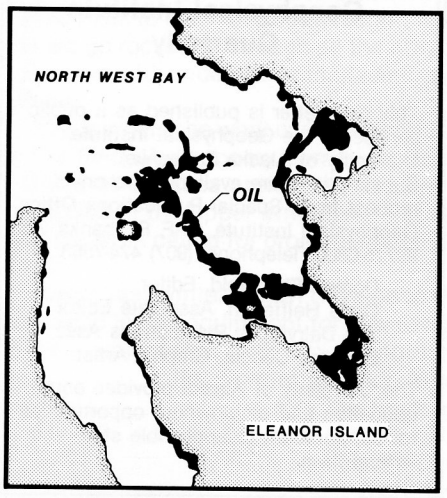
JIM COCCIA



Aurora stars at UA Museum

The Geophysical Institute and the University of Alaska Museum combined forces this year to create a special five-month exhibit, "In Light of the Aurora," which is showing at the museum through December 3. Organized from a historical perspective, the exhibit reviews understandings of the aurora from medieval times until the present. Hands-on displays in the exhibit include representations of the magnetic field, deflection of electron beams, the emission spectrum, computer displays (above, left), and an all-sky camera. Museum and institute staff worked on the exhibit for several months before its July opening. The exhibit was funded by the Sydney Chapman Fund, a grant-in-aid from the Alaska State Museum, and the City of Fairbanks.

Tracking the Spill



Although the new synthetic aperture radar (SAR) satellites are not yet in orbit, the Alaska SAR Facility image analysis system was available to help track oil from the March 24 *Exxon Valdez* spill and provide such background information as ocean temperatures, currents, suspended sediment patterns, and upwelling.

The result shown here is a map derived from a highly enlarged Landsat Thematic Mapper image of Eleanor Island, approximately 70 kilometers south of the spill site. By the April 7 image date, most oil had been transported past the island on its way out of Prince William Sound.

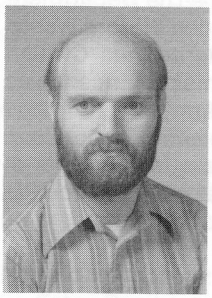
"In most cases the oil reflectance is only slightly greater than the ocean background, making it difficult to identify," said associate professor Bill Stringer of the institute. However, the SAR support equipment seemed up to the task. "We found the highly interactive software on the image analysis system particularly suited for this work, and believe it will be equally useful for distinguishing among radar backscatter levels associated with various types of sea ice on SAR imagery."

The map shows oiled beaches and, floating sporadically around the archipelago, long filaments and patches of oil. Some oil retained in Northwest Bay appears to be oiling a previously clean beach. A large patch of oil in the bay has a filament extending northwest to the nearby shore. Northwest of the label OIL, the beach is oiled; to the southeast it is not.

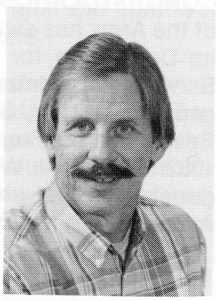
Installation and testing of equipment systems continues at the SAR facility, which is being prepared to receive data from remote sensing satellites that will be launched in the 1990s. SAR equipment enables the satellites to produce high resolution images even in conditions of darkness and clouds. The SAR installation at the institute is a $20 million project funded by the National Aeronautics and Space Administration.

GI Notes...

NEW FACES—The new assistant for operations at GI is **Robert Grove**, who previously worked for GI after arriving in Fairbanks in the late sixties. He was most recently the executive director of SIH, Inc. of Fairbanks. Several new faculty members have also joined the staff during the past year. Assistant professor **Paul Layer** is the new geochronologist, filling the position formerly held by Don Turner, who has retired. Layer was formerly at the University of Toronto physics department. **Hiroshi Tanaka**, assistant professor of physics, joined the atmospheric sciences group after receiving his doctorate from the University of Missouri-Columbia. His research background includes global energetics of atmospheric circulation, climatology, and



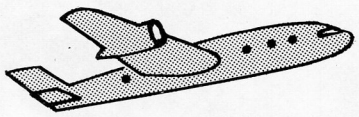
Knut Stamnes



Bob Grove

numerical modeling of large-scale motions. Research associate professor **Dan Weimer** has joined the space physics group from the U.S. Air Force Geophysics Laboratory in Massachusetts. He is involved in satellite measurements of electric fields above the ionosphere and in the magnetosphere. **Knut Stamnes**, professor of physics has rejoined GI after several years at the University of Tromsø. His present interests include planetary atmospheres (kinetic theory and radiation transport), atmospheric response to solar-terrestrial radiation and climatic implications (energy balance), and satellite remote sensing.

continued



ON LEAVE—Associate director for operations, **Merritt Helfferich**, is attending the John F. Kennedy School of Government master's degree program at Harvard University for nine months. He has been awarded the Alaska Nick Begich Scholarship for $250 and the Robert B. Seamans Technology and Public Fellowship for $5,000. Faculty members on sabbatical leave through May 1990 are **Dan Swift**, **John Olson**, and **Niren Biswas**. Swift is working at the Air Force Geophysics Laboratory, Bedford, Maine; Biswas is at the Department of Geological Sciences, University of Southern California, Los Angeles; Olson is at Newcastle University, Newcastle, Australia.

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POKER FLAT—Range supervisor **Neal Brown** is on sabbatical at University of Colorado Laboratory for Atmospheric and Space Physics for work on noctilucent clouds. **Chuck Deehr**, professor emeritus of geophysics, has been appointed scientific director of Poker Flat. Plans are underway to achieve a major upgrade of the facility, which has been operated by GI since 1969.

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CONGRATULATIONS—The Department of the Army has awarded **Wilford Weeks** its Decoration for Meritorious Civilian Service to recognize his performance as geologist at the U.S. Army Cold Regions Research and Engineering Laboratory, 1962-1989. At GI, Weeks is professor of geophysics and chief scientist for the Alaska SAR Facility.

VISITORS—**Ingrid Sandahl**, an exchange visitor from the Swedish Space Research Institute in Kiruna is visiting GI for six months, June-December, to work with the space physics and aeronomy groups. Solar physicist **Eric Priest** visited this summer from the the University of St. Andrews, Scotland, to lecture on solar flares and magnetic reconnections.

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INTERNS—Twelve undergraduates spent the summer at GI working on research projects under the direction of GI faculty: Kirk Hogenson, Christopher Larsen, Anupama Rao, and Russell Schwoerer of Fairbanks, Matthew Bierer of Williamson, New York, Clifford Chafin (Augusta Maine), Thomas Gadomski (Chicago Heights, Illinois), Samuel Gross (Millheim, Pennsylvania), Mary Hickman (Etowah, Tennessee), David Kula (Nashua, New Hampshire), Marshall Loewenstein (St. Louis, Missouri), Leslie McCullough (Bellingham, Washington). Participating scientists were **Roger Smith, Chuck Deehr, Hiroshi Tanaka, Tom Hallinan, Dave Fritts, Hans Stenbaek-Nielsen, John Olson, Dan Swift, David Stone, Doug Christensen, Brent Watkins, Bob Hunsucker.**

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COMING UP—The invasion of polluted air into the Arctic is the subject of "Arctic Haze," a 30-minute documentary produced at KUAC, the University of Alaska Fairbanks public television station. Professor Glenn Shaw, an early investigator of arctic haze, and other institute scientists contributed to the program, which is narrated by Noah Adams of National Public Radio's "All Things Considered." It will air November 2, 8:30 p.m. on public television stations throughout Alaska and nationally at a later date. The program was co-produced by Mark Badger and Joe Riley of KUAC.



JIM COCCIA

GI retirees, Paul Groves, Joe Knox, and Bob Hunsucker, donated their culinary skills to the Sourdough Pancake Feed, a breakfast to benefit Geo-Care, the employee assistance fund. Over $300 was raised.

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